

THE COLONISATION BY PLANTS OF THE RECLAIMED LAND NORTH OF THE NORTH MOLE.

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Resumen

La zona bajo estudio fue creada en 1989 cuando fue ganada al mar usando arena del propio fondo marino como material de relleno. Desde entonces este espacio ha sido colonizado por la vegetación. La mayoría son plantas que suelen crecer cerca del mar, pero otras no lo son. La mayor parte también pueden encontrarse en otras partes del Peñón, pero hay algunas que no se han observado en Gibraltar anteriormente. Este trabajo describe este nuevo hábitat y su colonización por plantas.

History

In 1989 the Gibraltar Government started a programme of land reclamation both inside and outside the harbour. In January 1989 work started on reclaiming a large area inside the harbour south-east of the North Mole. Landfill was carried out by using sand dredged from the sea bed off the East Side of the Rock. A month later, work started on reclaiming land north of the North Mole and adjacent to it. It is this area that this paper is concerned with.

By April most of the North Mole reclamation was completed and part of it already being used as a coach park. By January 1990 all reclamation work was complete, and work started on the construction of a building components factory on the site. This was completed on January 1991, and by January 1992 work on the area was finished off by the surfacing of the roads and pavements. By this time, a number of species of plants had already made an appearance.

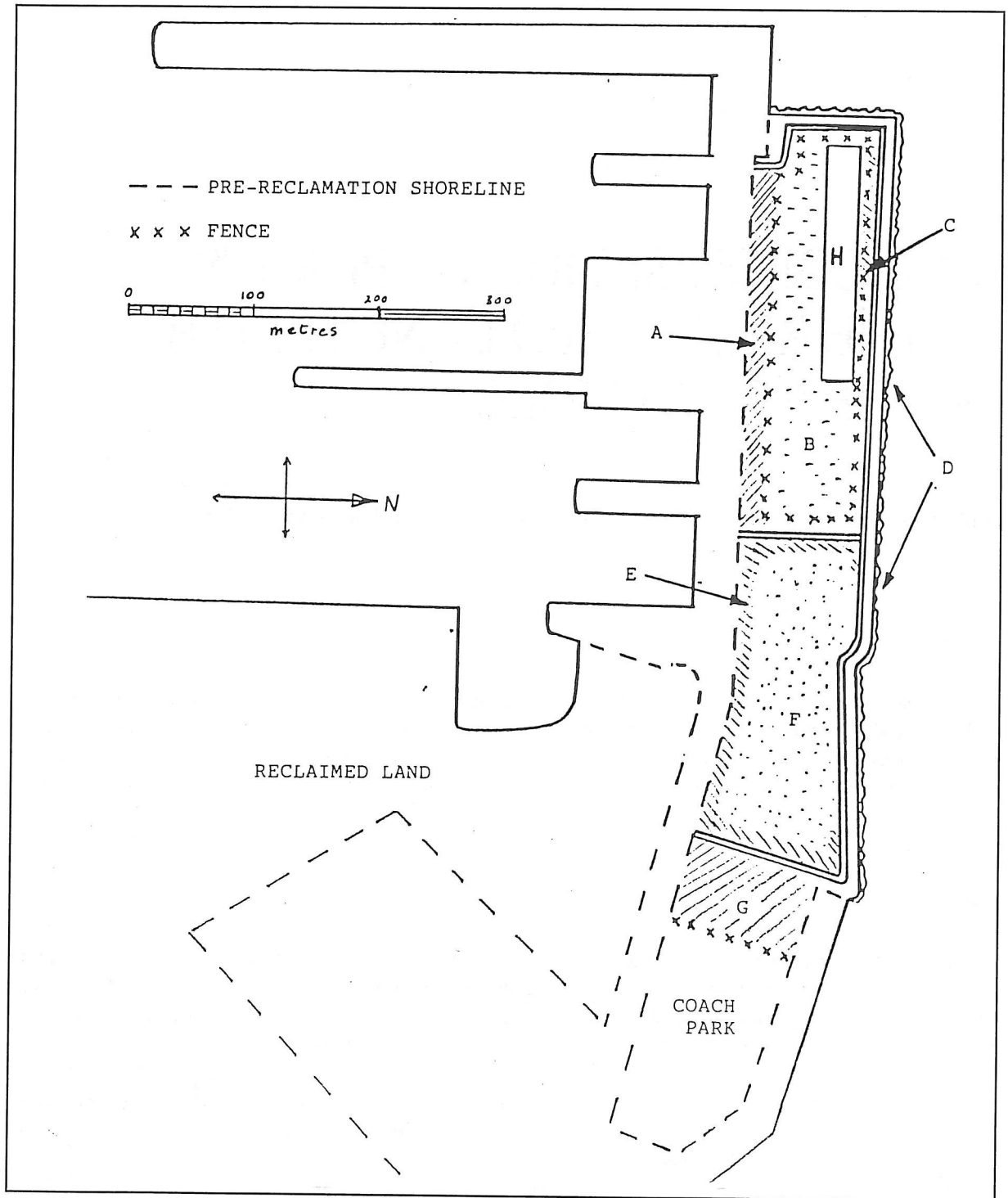


Fig. 1. Map of the whole area under observation.

The areas studied

The drawing on the next page shows a map of the whole area under observation. The site has been broken up into seven smaller areas which have been identified as having distinct characteristics. These areas are :

- A: Sandy waste ground by the roadside to the South of the fence enclosing the components factory (H). This area is not much disturbed though it seems to serve as a dumping site.
- B : The yard of the components factory where completed component blocks are deposited. Here the surface is largely concreted over.
- C : Narrow strip of waste ground North of the components factory. This area is generally in the shade as opposed to the rest which receive sunlight all day long.
- D : Retaining wall of limestone rocks brought from a quarry in Spain, near Manilva. This borders the pavement surrounding the complex.
- E : The roadside border of a large expanse of sandy waste ground. Here there is not a lot of disturbance, but large blocks and materials have been deposited.
- F : The central part of a large area of reclaimed land on which there has been no construction. This sector is used as a holding area for imported vehicles and therefore is subject to a large measure of disturbance. The sand here is constantly churned up.
- G : This sandy waste ground is closest to the town, and a lot of stuff is dumped onto it. A fair amount of construction has taken place to the West and South, and there is a lot of movement and disturbance nearby.

The species

Between January 1992 and the Summer of 1995 a total of 97 species were recorded within the whole complex. The table below shows a summary of the results of the study. It shows that during 1992 a total of 22 species had made an appearance. During 1993, 25 new species were recorded, making a total of 47. By the end of 1994, 23 new species had appeared, and the new total was 70. By the summer of 1995, the total reached 97 species with the arrival of an extra 27 new species.

The table also refers to the area within the complex where each species has been observed : each area can be identified on the map by the letters A to G. The table also gives the current status of each species in Gibraltar as a whole.

SPECIES RECORDED	DATE WHEN FIRST	AREA FOUND GIBRALTAR	STATUS WITHIN
<i>Amaranthus lividus</i>	1992	ACDEFG	very common
<i>Anacyclus radiatus</i>	1992	ABE	common
<i>Aster squamatus</i>	1992	ABCDEG	very common
<i>Asteriscus maritimus</i>	1992	BCDEG	very common
<i>Avena barbata ssp barbata</i>	1992	ADEFG	very common
<i>Calicotome villosa</i>	1992	BD	very common

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<i>Carduus tenuiflorus</i>	1992	G	very common
<i>Chenopodium album</i> ssp <i>album</i>	1992	ABCEFG	common
<i>Chenopodium ambrosioides</i>	1992	ACDEFG	very common
<i>Chrysanthemum coronarium</i>	1992	AE	very common
<i>Conyza albida</i>	1992	ABCDEFG	common
<i>Conyza bonariensis</i>	1992	ABCDEFG	very common
<i>Dittrichia viscosa</i>	1992	ABCDEG	common
<i>Hordeum leporinum</i>	1992	ACDEFG	very common
<i>Lactuca serriola</i>	1992	ABCDEG	not common
<i>Lobularia maritima</i>	1992	ABCDEFG	very common
<i>Lolium rigidum</i>	1992	ABCDEFG	very common
<i>Lotus arenarius</i>	1992	ABEFG	common
<i>Nicotiana glauca</i>	1992	ABDEG	common
<i>Ononis variegata</i>	1992	ABDEFG	newcomer
<i>Piptatherum miliaceum</i>	1992	ABCDEFG	very common
<i>Solanum villosum</i>	1992	ABCDEFG	very common
<i>Amaranthus blitoides</i>	1993	BDEFG	common
<i>Andryala integrifolia</i>	1993	ABCDEG	very common
<i>Crithmum maritimum</i>	1993	ABDE	very common
<i>Daucus carota</i> ssp <i>maximus</i>	1993	ABCDEG	common
<i>Echium gaditanum</i>	1993	ABE	newcomer
<i>Erodium chium</i> ssp <i>chium</i>	1993	ACD	very common
<i>Galactites tomentosa</i>	1993	ACDE	very common
<i>Hirschfeldia incana</i> ssp <i>incana</i>	1993	EF	common
<i>Iberis gibraltaria</i>	1993	BD	common
<i>Lagurus ovatus</i>	1993	ADE	very common
<i>Lotus creticus</i>	1993	AEFG	very common
<i>Malcolmia littorea</i>	1993	EG	common
<i>Malva sylvestris</i>	1993	ADEG	common
<i>Medicago littoralis</i>	1993	AEG	very common
<i>Melilotus indica</i>	1993	AG	common
<i>Phagnalon saxatile</i>	1993	BD	very common
<i>Plantago coronopus</i> ssp <i>coronopus</i>	1993	ACDEG	common
<i>Polycarpon tetraphyllum</i>	1993	BCDFG	very common
<i>Psoralea bituminosa</i>	1993	AD	very common
<i>Scabiosa atropurpurea</i>	1993	E	common
<i>Silene obtusifolia</i>	1993	ABD	very common
<i>Sonchus oleraceus</i>	1993	C	common
<i>Sonchus tenerrimus</i>	1993	ABCDEG	very common
<i>Trifolium stellatum</i>	1993	AB	very common
<i>Trisetum paniceum</i>	1993	EB	common
<i>Antirrhinum majus</i> ssp <i>cirrhigerum</i>	1994	ABDEG	very common

<i>Beta vulgaris</i> ssp <i>maritima</i>	1994	AE	very common
<i>Centaurea sonchifolia</i>	1994	GE	common
<i>Convolvulus althaeoides</i> ssp <i>althaeoides</i>	1994	E	very common
<i>Conyza canadensis</i>	1994	BD	newcomer
<i>Dactylis glomerata</i>	1994	BEG	very common
<i>Glaucium flavum</i>	1994	AD	common
<i>Lactuca tenerrima</i>	1994	ABD	common
<i>Lavatera cretica</i>	1994	AE	very common
<i>Leontodon longirostris</i>	1994	G	very common
<i>Parietaria judaica</i>	1994	BC	very common
<i>Petrorhagia nanteuilii</i>	1994	FD	rare
<i>Picris echioides</i>	1994	BD	rare
<i>Poa annua</i>	1994	C	common
<i>Rostraria cristata</i>	1994	ACE	common
<i>Rumex intermedius</i>	1994	C	common
<i>Senecio jacobaea</i>	1994	ABCD	rare
<i>Senecio vulgaris</i>	1994	BE	very common
<i>Stellaria pallida</i>	1994	C	common
<i>Triticum aestivum</i>	1994	A	newcomer
<i>Urospermum picroides</i>	1994	ABCDEF	common
<i>Verbascum giganteum</i> ssp <i>martinezii</i>	1994	DFG	rare
<i>Verbascum sinuatum</i>	1994	DE	rare
<i>Brachypodium distachyon</i>	1995	E	common
<i>Bromus madritensis</i>	1995	AEF	very common
<i>Calendula suffruticosa</i>	1995	AD	very common
<i>Carlina corymbosa</i>	1995	E	common
<i>Centranthus calcitrapae</i> ssp <i>calcitrapae</i>	1995	E	common
<i>Chenopodium rubens</i>	1995	C	common
<i>Crepis capillaris</i>	1995	CD	rare
<i>Erodium aethiopicum</i> ssp <i>pilosum</i>	1995	DF	newcomer
<i>Euphorbia terracina</i>	1995	E	rare
<i>Gnaphalium luteo-album</i>	1995	C	newcomer
<i>Heliotropium europeum</i>	1995	AEFG	not common
<i>Hippocrepis multisiliquosa</i>	1995	G	common
<i>Linaria pedunculata</i>	1995	B	not common
<i>Lotus edulis</i>	1995	G	common
<i>Lotus ornithopodioides</i>	1995	DG	common
<i>Oenothera erythrosepala</i>	1995	B	newcomer
<i>Ononis natrix</i> ssp <i>ramosissima</i> var. <i>gibraltarica</i>	1995	E	common
<i>Ononis pubescens</i>	1995	D	rare
<i>Polypogon monspeliensis</i>	1995	ABCD	newcomer

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<i>Pycnocomon rutifolium</i>	1995	E	very rare
<i>Reichardia gaditana</i>	1995	ABD	rare
<i>Scirpus holoschoenus</i>	1995	A	very rare
<i>Torilis arvensis</i> ssp <i>neglecta</i>	1995	C	not common
<i>Tribulus terrestris</i>	1995	G	common
<i>Trifolium angustifolium</i>	1995	G	rare
<i>Trifolium cherleri</i>	1995	G	newcomer
<i>Vulpia alopecuros</i>	1995	AE	not common

Arrival: Since the sand was dredged from the sea bed and therefore contained no seeds, it must be concluded that the seeds of the plants growing there must have arrived in bird droppings or on the legs of birds, borne on the wind, on the wheels of vehicles, and possibly some on the rocks forming the retaining wall. However the latter cannot be considered significant as most of the newcomers are coastal plants and the quarry from which the rocks were brought is inland.

First arrivals: It comes as no surprise that among the first plants to colonise were the typical plants of waste ground and of disturbed ground, namely :

Conyza bonariensis; *Conyza albida*; *Solanum villosum*;
Amaranthus lividus; *Aster squamatus*; *Chenopodium ambrosioides*;
Chenopodium album; *Anacyclus radiatus*; *Chrysanthemum coronarium*;
Carduus tenuiflorus; *Dittrichia viscosa*; *Lactuca serriola*; *Nicotiana glauca*.

The first three are found in all areas together with *Lobularia maritima*, *Lolium rigidum*, and *Piptatherum miliaceum*.

Newcomers: The most surprising discovery is the number of species which are newcomers to Gibraltar, as also the number of species found here which are rare elsewhere in Gibraltar.

Of the newcomers, the first to be noticed was *Ononis variegata*. This made its first appearance in area A in 1992, and by now has spread to all other sectors except the factory compound which is largely concreted over. The second newcomer to be noticed was *Echium gaditanum* which was first noticed in sector E in 1993, and has now spread to sectors A and B as well. The natural habitat of both these plants is coastal sands.

The other newcomers appeared during 1994 and 1995 as follows :

- 1994 : *Conyza canadensis* in regions B and D. This is generally a plant of waste and disturbed ground.
Triticum aestivum in region A. Often found as a relic of cultivation by roadsides and on waste ground.
- 1995 : *Erodium aethiopicum* in regions D and F. A plant of sandy soil, and of the littoral.
Gnaphalium luteo-album in region C. A plant of waste ground.
Oenothera erythrosepala in region B. A plant of waste ground.
Polypogon monspeliensis in regions A,B,C, and D. A plant of sandy soil, especially close to the sea.
Trifolium cherleri in region G. Widespread in the region.

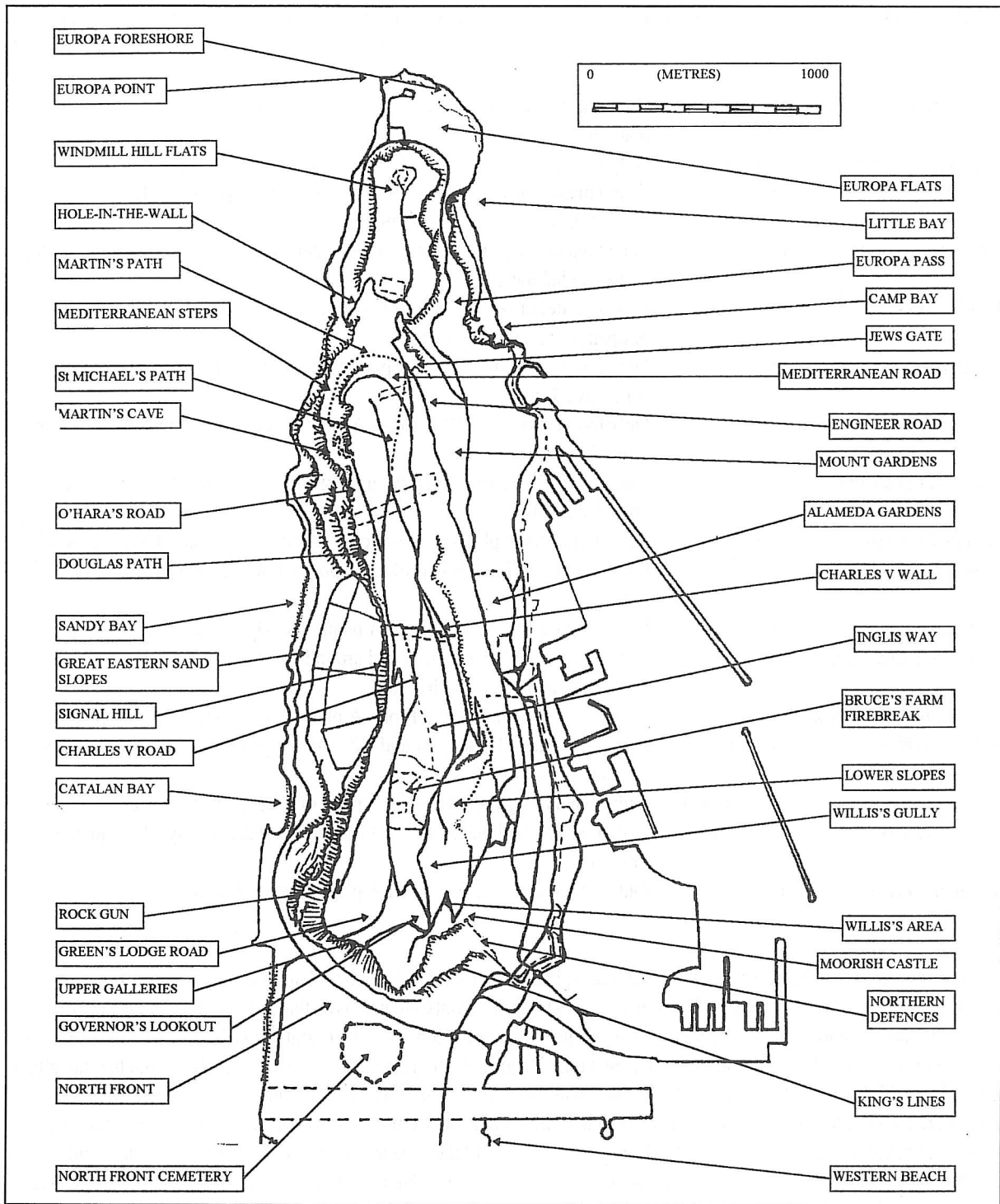


Fig. 2. Map of Gibraltar with the most interesants sites.

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Rare plants: Of the species present quite a number are not common, and even rare elsewhere on the Rock. These species are :

<i>Pycnocomon rutifoliium</i>	very rare	Only rarely found along the frontier fence; common on the Spanish side. A plant of coastal sands
<i>Scirpus holoschoenus</i>	very rare	Only recorded from North Front Cemetery. A plant of damp places.
<i>Crepis capillaris</i>	rare	Found mainly at North Front Cemetery and isolated plants scattered elsewhere. A plant of waysides and waste places.
<i>Euphorbia terracina</i>	rare	Found mainly at North Front Cemetery and a few along the East Side. A plant of coastal habitats.
<i>Ononis pubescens</i>	rare	Found scattered between the Willis's area and Governor's Lookout. A plant of open spaces; waste ground.
<i>Petrorhagia nanteuillii</i>	rare	Found along Mediterranean Steps and along King's Lines. A plant of sandy soil; waysides.
<i>Picris echioides</i>	rare	Only found along Line Wall Road. A plant of waste places and brackish marsh ground.
<i>Reichardia gaditana</i>	rare	Found at North Front Cemetery and along the East Side. A plant of sandy coastal habitats.
<i>Senecio jacobaea</i>	rare	Scattered isolated plants appear around Gibraltar. A plant of waste ground.
<i>Trifolium angustifolium</i>	rare	Only found at Windmill Hill Flats. A plant of dry open ground, and of waste places.
<i>Verbascum giganteum</i>	rare	Only found along the East Side. A plant of sandy soil; coastal habitats.
<i>Verbascum sinuatum</i>	rare	Scattered isolated plants are found around Gibraltar. A plant of stony and sandy soil, and of coastal habitats.
<i>Heliotropium europeum</i>	not common	Mainly found around North Front. A plant of waysides and waste places.
<i>Lactuca serriola</i>	not common	Found in scattered places around Gibraltar. A plant of waste and disturbed ground.
<i>Linaria pedunculata</i>	not common	Only found along the East Side. A plant of sandy, coastal places.
<i>Torilis arvensis</i>	not common	Found in scattered places around Gibraltar. A plant of waysides and waste ground.
<i>Vulpia alopecuros</i>	rare	Only found along the East Side. A plant of coastal sands.

It is not surprising that the only other places in which the majority of these rare plants have been recorded in Gibraltar are North Front Cemetery and the East Side sand slopes. The North Front Cemetery is all that remains in more-or-less a natural state of the sandy isthmus that linked Gibraltar to Spain; this isthmus consisted of coastal sands. The East Side sand slopes were formed by wind-blown coastal sands. The reclaimed land is, to all intents and purposes, a sandy coastal habitat, albeit artificial, and this has provided these plants with an extension to their usual haunts. The fact that the plants found in the original habitats are locally rare can be attributed to the fact that (a) North Front Cemetery is a small area which is under continuous disturbance not just by grave-diggers but by the regular strimming of the vegetation; and (b) most of the East Side sand slopes have been covered by corrugated iron sheets for water collection, and another large area is covered by *Carpobrotus edulis*, which inhibits the spread of native species.

Many of the other species found on the reclaimed land are precisely plants of coastal habitats; either of coastal sands or rocks. 29 out of the 97 are so, making up 30% of species. Examples of these are :

Asteriscus maritimus; Lobularia maritima; Lolium rigidum; Lotus arenarius; Lotus creticus; Crithmum maritimum; Malcolmia littorea; Medicago littoralis; Plantago coronopus; Scabiosa atropurpurea; Silene obtusifolia; Beta vulgaris maritima; Centaurea sonchifolia; Glaucium flavum; Ononis natrix ramosissima; Tribulus terrestris;

Many of the other plants, both rare and common, are plants of waste places and of disturbed ground. 31 out of the 97 are so, making up 32% of species. Examples of these have already been given above. The remaining 37 species, which make up 38% of the total, comprise those which are found in a wide variety of habitats, including the littoral, waste ground, roadsides, clearings, etc.

The areas : The number of species found in each area is as follows :

Area A	51 species	Large number of species due to little disturbance, and being by the roadside.
Area B	41 species	Few species due to concrete slabs covering most of the area.
Area C	34 species	Few species due to smaller area and lack of direct sunlight.
Area D	49 species	Large number of species due to presence of limestone rocks as well as sandy soil.
Area E	55 species	Large number of species. Habitat virtually the same as that of area A.
Area F	23 species	Least number of species due to constant disturbance by vehicles.
Area G	42 species	Few species due to greater disturbance than most other areas.

Concluding comments: This whole area will no doubt be developed in the future, and much of the sandy habitat will disappear. This will of course mean that a few of the species found here will also disappear, and only a record of their having been here will remain. However, certain areas are bound to remain unchanged, especially the rocky boundary along the northern coastline. Luckily this area contains some of the newcomers and also many of the rare species, in particular :

Picris echioides; Lactuca serriola; Conyza canadensis; Senecio jacobaea; Reichardia gaditana; Crepis capillaris; Petrorhagia nanteuillii; Ononis variegata; Ononis pubescens; Erodium aethiopicum; Verbascum giganteum; Verbascum sinuatum; Polypogon monspeliensis.

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